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(54) Title: IMPROVED PERFORMANCE CAST DETERGENT

(57) Abstract

A solid cast warewashing composition having improved soil removing properties is produced for use in automatic washing machines. A liquid detergent composition is cast and solidified in a mold. The solid cast detergent, surrounded on all but its upper surface by the mold, is used in automatic washing machines having a dispensing device designed to dispense a liquid aqueous detergent formed from the solid cast detergent using an impinging liquid spray. The liquid aqueous detergent flows out of the dispensing device generally simultaneously with its formation in the dispenser. The cast detergent composition includes at least about 0.1 wt.% of a selected nonionic surfactant, an alkali metal hydroxide, a sequestrant, water of hydration and optionally further an available chlorine source, a defoamer, or the like.

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IMPROVED PERFORMANCE CAST DETERGENT

Field of the Invention

The invention relates to a novel solid cast warewashing detergent useful to prepare low foaming aqueous detergents. The detergents are formulated with an optimized content of a selected biodegradable nonionic material to enhance soil removal, with little foaming, in institutional dishwashing machines and industrial washing machines. The invention also relates to a method for producing the low foaming detergent containing article. The invention also relates to a method for using the detergent containing article. The materials of the invention can remove food soils, preferably proteinaceous and dairy soils, efficiently with little or no associated filming or residue buildup.

Background of the Invention

Solid cast high performance detergent containing articles are known for use in institutional dish or warewashing machines and industrial washing machines using an aqueous cleaning medium at both high (145°F and up) and low (120°-145°F) water temperature. The advent of such high performance products was stimulated in part by increased aesthetic and sanitary requirements and a demand for shorter wash times. Such high performance products are generally complex detergent compositions that possess high alkalinity as a soil removing/degrading component (e.g., substantial concentrations of sodium hydroxide). In addition to a source of alkalinity, chemicals used in high performance products, particularly for hard surface cleaning (e.g., warewashing) include additional sources of alkalinity, organic and inorganic sequestrants such as a poly acrylic acid material, NTA, polyphosphates, chlorine-containing compounds, nonionic defoamers, thickeners, etc.

A source of available chlorine is often included to control food stains, such as tea and coffee stains. The

defoamer is often included to control foam created by an interaction between proteinaceous soil, saponified fats and water in the cleaning medium. See Mizuno et al., U.S. Patent No. 3,166,513; Sabatelli et al., U.S. Patent No. 3,535,285; Sabatelli et al., U.S. Patent No. 3,579,455; Mizuno et al., U.S. Patent No. 3,700,599; and Copeland et al., U.S. Patent No. 3,899,436.

Commonly, nonionic defoaming compositions used in available compositions comprise a pluronic or reverse pluronic nonionic. Pluronic nonionics comprise a nonoionic EO block-PO block-EO block stricture. Reverse pluronics have a PO block-EO block-EO block structure. These materials are common in detergent chemistry and particularly in cast solid detergent technology. These materials are typically used in an amount of about 0.1 to about 1.5 wt-% to obtain suitable defoaming of aqueous wash compositions made using effective amounts of the detergent composition.

The high alkaline compositions of the prior art, while generally effective, can experience a reduced effectiveness depending on water conditions, soil type, water temperatures, etc. Morganson et al., U.S. Pat. No. 5,080,819 teach the use of a proportion of a broad range of types of nonionic material to enhance cleaning.

We have found that a particular soil arising from highly proteinaceous foods such as dairy products form a film highly resistant to removal using conventional warewashing detergents that can include typical nonionic defoamer compositions. Typically, coffee cups and drinking glasses are particularly subject to formation of proteinaceous dairy derived soil residues. Glasses used to serve milk, chocolate milk, shakes, malts, floats, etc. which come in contact with substantial proportions of dairy protein, obtain a stubborn film resistant to cleaning using alkaline material. Further, coffee cups used in serving coffee combined with

creamers (whole cream, half-n-half, non-dairy creamer substitutes) can also form a dairy based stubborn film resistant to removal using alkaline cleaner materials. We have found that because of the reuse frequency of glasses and cups, the proteinaceous dairy derived films rapidly form and become a relatively permanent film present on the surface of the silicate or ceramic surfaces. We have found that in large part, the nonionic defoamer materials either participate in the formation of the films or have little or no efficacy in their removal during warewashing. These films can also form on other ware if washed in batches containing dairy soil contaminated cups or glasses.

Due to environmental concerns and requirements, a strong need for biodegradable or environmentally friendly materials in cast solid detergents are needed. Many nonionic materials that can defoam or effectively increase the cleaning power of alkaline detergents have been found but are slow to degrade in environmental conditions. Many of the Morganson et al. surfactants are not considered to be biodegradable under current standards. We have also found many nonionic materials that are effective cleaners, and are biodegradable, but are unfortunately high foaming. Accordingly, while the materials satisfy requirements for cleaning and biodegradability, their use is limited by the degree to which they foam during cleaning operations in institutional or industrial cleaning apparatus. The generation of high levels of foam can interfere with contact between the surface of the ware and a cleaning spray, can interfere with pumping the aqueous cleaning medium through the machines, and can cause an overflow of foam from the machines creating a hazardous situation in the cleaning location. In our work to effectively defoam the alkaline materials having cleaning nonionics, we have found a class of nonionic soil removing compositions that effectively defoam but are also

biodegradable. The biodegradable cleaning nonionic material and the biodegradable foam control nonionic material cooperate in the detergent to produce excellent cleaning and in particular, excellent soil and protein removal leaving little or no film or residue while generating little or no foam during cleaning operations.

Summary of the Invention

We have also found that the cleaning problems described above can be minimized by forming a solid cast detergent containing a defoaming composition and a biodegradable capped alcohol ethoxylate nonionic soil removing composition in a disposable mold. The detergent is used and dispensed by a water spray directly from the mold/cast detergent combination. The cast detergent composition comprises an alkali metal hydroxide, at least about 0.5 wt-% (0.1 to 15 wt-% can be used, preferably 0.2 to 5 wt-%, most preferably 0.25 to 1 wt-%) of a capped alcohol ethoxylate soil removing surfactant, a hardness sequestering agent and water of hydration. The combination of the cast detergent and the disposable mold in which it was formed provides an article of commerce capable of dispensing dissolved solids from substantially only one side of the surface which was the free or unsupported surface in the mold. Alternatively, the solid cast detergent composition can be removed from the mold in which it is formed prior to use.

The nonionic soil removing detergent composition has the formulae:

$$RO-(EO)_x-A$$

wherein A is any capping moiety, preferably A is a non-aromatic capping moiety and x is 6 to 50, preferably 6 to 40, and most preferably 6 to 20. The preferred end group or capping moiety is a butylene oxide cap $(BO)_y$ wherein y is 1-5, preferably 1-3. The nonionic soil

removing detergent compositions are ethylene oxide based block materials having an end or capping group. The end cap moieties (cap A) is derived from compounds that form otherwise stable capping moieties. The end caps can be formed from C_4 or higher alkylene oxide including 1,2-butylene oxide, 2,3-butylene oxide, 1,2-pentene oxide, etc. The end moieties can also comprise alkyl, aliphatic or aromatic end groups. Alkyl groups can include methyl, ethyl, propyl, isopropyl, n-butyl isobutyl, cyclohexyl, benzyl, tolyl, xylyl; halogens including chloro, bromo, iodo, etc.; halo alkane such as chloro methane, chloro butane, dichloropentane; alcohols such as methanol, ethanol, 2-propanol, cyclohexanol, polyhydric alcohol such as 1,2-ethane diol, 1,4-benzene diol and the like; mercaptans such as methane thiol, 1,2-methane dithiol and the like; moieties formed from reactive compounds such as epichlorohydrin, tetramethylene oxide, aldehydes, ketones, carboxylate containing compounds such as the alkali metal salts of carboxylic acids and the esters of carboxylic acids and their anhydrides. The above listing is exemplary and not intended to be limiting since the chemically stable end groups that stabilize the polymer and provide its cleaning activity are known in the manufacturing of block nonionic materials.

The detergent composition is normally formed by mixing and heating the components in an aqueous solution, thickening the solution, pouring the solution into the mold and preferably also cooling it, and allowing the mixture to solidify. The solidification can involve one or more physico-chemical mechanisms, including "freezing", precipitation from solution, hydration, etc. Preformed plugs or cores of a chlorine source and/or a defoamer can be inserted in the mixture after it has been added to a mold and before it has solidified.

The cast detergent composition is preferably left

in the disposable mold in which it was cast. Alternatively, the cast detergent can be demolded and inserted in an inexpensive container or receptacle or directly into a dispenser which has substantially the same configuration as the mold, since in either case the cast detergent is surrounded on all but one surface, as described previously. The thus-surrounded cast detergent is used by placing its exposed surface in a drainable position (preferably fixed) within a detergent dispensing apparatus. A fixed drainable position is one in which the aforementioned unsurrounded, exposed surface is fixed with respect to the horizontal and a potential impinging spray of liquid such that the unsurrounded, exposed surface permits gravity flow therefrom, either because of an inclination from the horizontal by a degrees (e.g., by 10-90°) or by inclination beyond 90°, i.e., partial or total inversion up to and including a totally inverted or downward-facing position. A spray of liquid impinging on the drainable (inclined or inverted) surface, suitably controlled in duration, provides a draining action or gravity flow of liquid detergent which drains downward off of the drainable surface to the washing machine into which the detergent is to be dispensed. Control over the duration of impingement (hence the duration of downward flow) has the effect of controlling the concentration of detergent in the washing machine. The dispensing apparatus is not a water-in-reservoir type, since it dispenses the flow of liquid detergent about as fast as this flow is formed by the spraying action.

We have found that food soils, preferably proteinaceous soils, most preferably dairy based soils, can be removed with surprising effectiveness using highly alkaline cast solid detergent containing a soil removing nonionic material comprising a capped polyethylene oxide polymer. We have found that many nonionic materials currently used in warewashing systems

either fail to remove proteinaceous films or soils from hard surfaces or cooperate with the soil sources to form tenacious films. However, regardless of the soil nature, the capped polyethylene oxide nonionic soil removing materials of the invention cooperate with the other components of a cast solid detergent to substantially increase the cleaning capacity of the cast solid detergents resulting in cleaned ware with no tendency to promote filming or other hard to remove soil type. These nonionic materials are preferred for use in the cast solid detergent compositions because of their performance and biodegradability. These materials when introduced into the environment after their use in cleaning, rapidly degrade to nontoxic residues that can be metabolized by organisms in the environment.

Certain of the soil removing surfactants set forth above can generate foam. Others can be used without substantial foam generation, however the cast solid detergents of the invention using the improved nonionic surfactant materials can be made with a defoaming nonionic to further improve soil removing performance.

The solid cast warewashing composition of the present invention should comprise about 0.1 to 15 wt-% of a nonionic surfactant for reasons of fatty soil emulsification, preferably about 0.2 to 10 wt-% for reasons of optimum fatty soil emulsification, and most preferably about 0.3 to 9 wt-% for reasons of most optimum soil emulsification.

One necessary component for producing the solid cast detergent composition of the present invention is an alkali metal hydroxide. Suitable alkali metal hydroxides include, but are not limited to, the following: sodium hydroxide and potassium hydroxide. Preferably the solid cast detergent composition comprises sodium hydroxide for economic reasons. These materials are available in aqueous concentrate or in bead form. The alkali metal hydroxide will normally

comprise about 10 to 60 wt-% of the detergent composition for reasons of chemical soil removal, preferably 20 to 50 wt-% for reasons of more cost effective soil removal, and most preferably about 35 to 50 wt-% for reasons of most cost effective soil removal. If the alkali metal hydroxide concentration is too low, chemical soil removal performance will deteriorate. If the alkali metal hydroxide concentration is too high, an increase in use cost will result.

A second necessary component of the solid cast composition of this invention is water. Water is used in combination with alkali metal hydroxide to form a meltable carrier medium containing the detergent components; the medium being cast into a mold and solidified by a solidification mechanism described previously. Water may be added as a separate ingredient or in combination with one of the other components, for example as an aqueous solution of 50% sodium hydroxide.

The water of hydration will normally comprise about 5 to 30 wt-% of the detergent composition, preferably about 10 to 20 wt-% for reasons of keeping the mixture fluid and processable at a temperature ranging from about 155-180°F and most preferably about 12 to 15 wt-% for reasons of keeping the mixture fluid and processable at a temperature ranging from about 155-180°F.

A third necessary component of the solid cast detergent composition is a sequestrant. The solid cast warewashing composition of the present invention should comprise about 16 to 50 wt-% of sequestrant, preferably about 15 to 34 wt-% for reasons of cost performance legal restrictions, and most preferably about 20 to 30 wt-% for reasons of optimum cost performance.

The service water commonly employed in cleaning baths contain substantial proportions of hardness ions most commonly calcium and magnesium ions, which can react with detergent components to decrease cleaning effectiveness and/or leave unsightly deposits upon the

substrate being cleaned. Sequestrants act to prevent or delay crystal growth of calcium or magnesium compounds and thereby eliminate their reaction with other components and/or their precipitation. Suitable sequestrants for use in the solid cast detergent composition of the present invention include organic and inorganic sequestrants. Organic sequestrants include a broad class of materials that can complex hardness ions such as calcium, magnesium, iron, manganese and others. Organic sequestrants include EDTA (ethylene diamine tetraacetic acid and its salts), NTA (nitrilotriacetic acid and its salts), polyelectrolytes such as polyacrylic acid and its copolymers, polymaleic acid and its copolymers and others. Inorganic hardness sequestering agents include condensed phosphates, particularly phosphates of the formula $M-(PO_3M)_nOM$ wherein M is an alkali metal and n is a number ranging from 1 to about 60, typically less than 3 for non-cyclic phosphates, typical examples of such phosphates being sodium or potassium orthophosphate and alkaline condensed phosphates (i.e., polyphosphates) such as sodium or potassium pyrophosphate, sodium tripolyphosphate, sodium hexametaphosphate, etc. Preferably, the sequestrant comprises sodium tripolyphosphate for reasons of sequestration, peptizing, and soil suspension.

Preferably, the sequestrant is utilized in its anhydrous form for reasons of cost. However, a sequestrant in its hydrated form could be utilized if the water content of the other raw materials is adjusted downward to compensate for the water of hydration contained in the sequestrant.

In addition to those components previously described, other conventional detergent components and fillers can be included. For example, it is possible to include a defoamer.

Defoamers, in addition to the above-mentioned

nonionic surfactants, can also be included in the solid cast detergent composition. Defoamers will normally comprise minor amounts of the solid cast detergent composition, i.e. about 0.1 to 5 wt-%, for reasons of cost performance, preferably about 0.1 to 2.0 wt-% for reasons of optimum cost performance, and most preferably about 0.2 to 0.5 wt-% for reasons of most optimum cost performance. Typically, a "defoamer" is a chemical compound with a hydrophobe\hydrophile balance suitable to reducing the stability of protein foam. The hydrophobicity can be provided by an oleophilic portion of the molecule (e.g., an aromatic alkyl or arylalkyl group. The hydrophilicity can be provided with oxyethylene units in chains or blocks and/or ester groups (e.g., organophosphate esters), salt-type groups, or salt-forming groups. Typically, defoamers are nonionic organic block polymers having hydrophobic groups or blocks or chains and hydrophilic ester groups, blocks, units, or chains. For a disclosure of nonionic defoaming surfactants, see U.S. Patent No. 3,048,548, issued August 7, 1962 (Martin et al.), U.S. Patent No. 3,334,147, issued August 1, 1967 (Brunelle et al.), and U.S. Patent No. 3,442,242, issued May 13, 1969 (Rue et al.). Phosphate esters are also suitable, e.g., esters of the formula $RO-(PO_3M)-_nR$, wherein n is as defined previously and R is an organic group or M (as defined previously), at least one R being an organic group such as an oxyalkylene chain.

The solid cast detergent composition can optionally further comprise about 1 to 20 wt-% of hydratable, crystalline alkali metal silicate for reasons of soil suspension, and providing alkalinity and corrosion protection, preferably about 10 to 20 wt-% for reasons of providing optimum soil suspension, providing additional alkalinity and corrosion protection and most preferably about 12 to 18 wt-% for reasons of providing most optimum soil suspension, providing additional

alkalinity and corrosion protection.

Alkali metal silicates are the reaction product of an alkali metal oxide (M_2O) and silicone dioxide (SiO_2) and have the general chemical formula $(M_2O)_x:(SiO_2)_y$ wherein x and y indicate the molar ratio of alkali metal oxide to silicon dioxide.

Methods of manufacturing alkali metal silicates having various x:y mole ratios are well known as demonstrated by the general disclosure in Kirk Othomer Encyclopedia of Chemical Technology, 2d Ed., Vol. 18, pp. 139-141. The desired properties and benefits of the solid cast detergent composition described herein can be obtained by using an alkali metal silicate having an x:y ratio of about 1:1-3:1, preferably 1:1-2:1. At these ratios, the alkali metal silicate has sufficient alkaline character to clean effectively and sufficient silicon dioxide to protect aluminum, china, glassware, etc. from the etchant effect of basic components in the composition. These silicates also have excellent solidification properties.

For reasons of high cleaning performance, delicate ware protection and low cost, the most preferred alkali metal silicate is sodium metasilicate having an $Na_2O:SiO_2$ ratio of about 1:1-2.1. Preferably anhydrous alkali metal silicate is utilized to minimize water content in the final product and optimize use cost by concentrating the product.

The solid cast detergent composition can optionally further comprise a carbonate such as sodium carbonate and potassium carbonate. Carbonates can comprise about 1 to 30 wt-% of the detergent composition, preferably about 1.5 to 25 wt-% for reasons of cost optimization, and most preferably about 1.5 to 20 wt-% for reasons of optimum cost optimization.

Carbonates serve the following function in the solid cast detergent composition of the present invention, they hydrate water and solidify the product

in its container. The solid cast detergent composition can optionally further comprise a dye. Dyes can comprise about 0.0 to 0.2 wt-% of detergent composition, preferably about 0.0 to 0.1 wt-% for reasons of cost and desired hue, most preferably about 0.005 to 0.05 wt-% for reasons of optimum cost and desired hue.

The solid cast detergent composition can optionally further comprise about 0 to 5 wt-% of a salt such as sodium chloride and/or sodium sulfate for purposes of a filler. Typically, four component compositions of the solid cast detergent composition of this invention can be formulated from (1) at least about 0.2 wt-% of a low foaming nonionic soil removing surfactant (with a defoamer if needed), (2) a phosphate or other hardness sequestering agent, (3) an alkali metal hydroxide, and (4) water. Typically, five or six component compositions would further include a neutral inorganic salt (alkali metal halides, sulfates, etc.) and/or a thickening agent, thixotrope, suspending agent or organic chelating or sequestering agent, or the like.

The article of the invention can also comprise a disposable container or mold into which the detergent composition is cast or allowed to solidify. During shipping, the article will normally include a lid or cover. The lid or cover can be made of the same or similar material as used to make the mold. As will be explained subsequently, this material is ordinarily alkaline resistant, nonbreakable, and inexpensive. Expensive corrosion-resistant metals or plastics can be used, if provision can be made for their recycling, but "disposable" materials would normally be preferred for most institutional uses. The solid cast detergent composition is typically surrounded by and in contact with the mold on all but the upper surface of the solid cast detergent. A cross-section of the solid cast detergent can be more than a centimeter thick (e.g., 2-20 cm thick). The area of the upper surface can easily

exceed 100 cm^2, e.g., 125 cm^2 to 1000 cm^2 or more. Unlike compressed detergent tablets, it has been found that cast detergent blocks can be made very large -- almost any desired size.

The mold or container can be made of any alkali-resistant material which can withstand moderately elevated temperatures, e.g., 150°F, and which can be formed into and hold the desired shape. Since the mold is generally intended to be "disposable" (i.e., not intended for reuse as a mold), inexpensive materials are preferred such as thermoplastics, resin-impregnated heavy paper or cardboard, and the like. Inexpensive but fragile material such as glass or ceramics are less preferred due to handling or shipping problems, relatively flexible materials being preferred. Molds made of plastic (e.g., inexpensive thermoplastics) have been found to be particularly useful.

The solid cast detergent containing article can be used in conjunction with a detergent dispensing apparatus which can be part of a conventional institutional or industrial washing machine. The article, including base detergent and container is placed in a totally downward-facing or totally inverted position over a spray means which is connected to a water source, whereby the exposed surface of detergent becomes a drainable surface. When the water source is turned on, the spray means causes water to impinge on the exposed surface of detergent. The detergent dissolves, creating a gravity flow of liquid aqueous detergent which flows downwardly through a pipe to a wash tank or washing zone of the washing machine. The detergent composition can be formulated to dissolve at substantially the same rate and thus supply the tank with a consistent ratio of ingredients.

By controlling the spray time, the amount of detergent, and thereby the concentration of detergent, the wash can be controlled. In other words, the liquid

aqueous detergent formed as a result of the impingement of the spray on the exposed surface of detergent flows by gravity into a pipe generally simultaneously with its formation within the dispensing apparatus. Standing water or aqueous liquid is not permitted to accumulate within the dispensing apparatus.

Method of Manufacturing Cast Detergent

The solid cast detergent composition of the present invention can be formed by a number of methods including, but not limited to, batch processing and semicontinuous processing.

While the following processes are described with reference to specific components, it should be understood that other components and similar processes can be used to form a detergent solution which can be cast into a mold and which will solidify upon hydration of its hydratable component to form a solid cast detergent composition. The solid cast detergent composition of this invention can be manufactured by combining the components in a suitable mixer having sufficient resistance to chemical attack from the ingredients and sufficient mixing capacity. While the ingredients can be mixed generally in any order without substantially reduced properties, the preferred mode of preparing the composition is first charging to a large industrial scale mixer an aqueous solution of an alkali metal hydroxide. Mixing and heating the aqueous solution of alkali metal hydroxide result in a mixable fluid matrix. Into the aqueous solution in the industrial mixer can then be placed the balance of the components. If the sequestrant utilized contains phosphate, it is preferably added near the end of the process in order to minimize phosphate reversion.

The industrial mixer is operated at a sufficient speed and horsepower and temperature range to insure adequate mixing of the components. Once the components

are fully mixed and uniform, the composition is drawn off into molds or capsules for solidification.

During processing the components are preferably mixed and drawn off into the capsule or mold while maintaining the temperature of the composition at about 144-155°F for reasons of keeping the product molten and thus processable, preferably about 144 to 150°F for optimum processability. The process must be run at a minimum of about 144°F throughout in order to maintain a molten product.

A particularly useful detergent composition of this invention is formed by heating about 60 to 70 parts by weight of a 40-75 wt-% aqueous solution of an alkali metal hydroxide, e.g., sodium hydroxide, to a temperature of about 144-155°F, preferably about 144-180°F for reasons of optimum processing. The alkali metal hydroxide solution is then mixed at a sufficient rate for effective heat distribution and in order to keep the solution mixed and flowing. While other alkali metal hydroxides may be used, sodium hydroxide has been found to be particularly useful and the following method of manufacturing will be described with respect to it. Aqueous solutions of 50 wt-% sodium hydroxide are readily commercially available. Solutions containing higher weight percents of sodium hydroxide are also available (e.g., 73%) or can e produced by adding a desired amount of anhydrous sodium hydroxide to a 50 wt-% solution of sodium hydroxide. An aqueous solution of sodium hydroxide can also be prepared by mixing water and anhydrous sodium hydroxide in the desired ratio. About 30 to 40 wt-% of anhydrous sodium hydroxide beads, preferably about 35 to 40 wt-% for reasons of establishing the proper matrix, and most preferably about 34 to 36 wt-% are then added to the mix tank. The addition of the anhydrous sodium hydroxide beads brings up the concentration of sodium hydroxide in the mixture to its final level. With the addition of the anhydrous

sodium hydroxide beads there is no longer any free water in solution resulting in a molten matrix.

Next, the nonionic soil removing surfactant is added to the mix tank. The soil removing surfactant alone can be added with a defoamer mixed or sequentially. Mixing should occur for a sufficient amount of time in order to render the mix tank contents homogeneous. About 20 to 35 wt-% of a sequestrant such as sodium tripolyphosphate can then be added to the mix tank. Alternatively, a sodium tripolyphosphate surfactant premix can be added at this time.

About 20 to 35 wt-% of a sodium tripolyphosphate surfactant premix can then be added to the mix tank. The "sodium tripolyphosphate surfactant premix" is as defined in Example 1. Phosphate containing compositions are preferably added late in the process to minimize phosphate reversion.

About 0 to 0.05 wt-% of a dye can then be added to the mix tank contents. The dye is typically added near the end of the process to protect the dye, but not so late that there is sufficient time for the dye to be adequately blended with the mix tank contents.

After the sequestrant such as a polyphosphate and/or optional fillers or components (the polyphosphate is a preferred ingredient, are added, the mixture can be cooled. Continuous mixing can be used during any dissolving, cooling and thickening steps. The cooled and thickened mixture is poured into a receptacle-shaped mold to a level at least part way up the side molding surfaces. As the mixture continues to cool, it will solidify to form a cast composition. Solidification is believed to be substantially due to cooling. (This invention is not bound by a theory, however). After it has solidified, the cast detergent is surrounded by and in contact with the mold on all sides except for its upper surface which remains exposed.

The present invention will be further understood by

reference to the following specific Examples which are illustrative of the composition, form and method of producing the solid cast detergent containing article of this invention. It is to be understood that many variations of composition, form and method of producing the cast detergent would be apparent to those skilled in the art. The following Examples, wherein parts and percentages are by weight unless otherwise indicated, are only illustrative.

Experimental

The invention is a performance improvement with the surfactants used in automatic dishwash detergents. The improvement is an improved ability to remove dried protein soil residues from tableware. Results are measured as better spot grades on glasses. The benefit is tableware with an improved appearance.

The specific surfactant used to improve performance is a nonionic with the following structure:

C_{13-15} alkyl-O-$(EO)_{8-10}(BO)_{1-2}$

EO = Ethylene Oxide

BO = Butylene Oxide

The reason that new surfactants were investigated is that the block polymer nonionics commonly used do not remove dried protein soil from tableware. We think that protein residue from coffee creamer adheres to the inside of coffee cups and becomes stained. This is very unsightly and causes customer complaints.

The experimental method used to demonstrate the performance benefit is a laboratory spot and film test. The procedure and equipment is as follows:

This is a 20 cycle test using a Hobart C-44 high/temperature conveyor rack machine. During the test, city water (5 grains) was used. Temperatures were 165°F wash and 185°F rinse. To the wash water was maintained 500 ppm food soil consisting of a 50/50 mixture of pureed Dinty Moore Beef Stew and Hot Point Soil. Hot Point Soil is made from a mixture of 4 parts Blue Bonnet margarine and one part Carnation powdered milk. The glasses that were run through the 20 cycle test were dipped completely inside and out into Land-O-Lakes whole milk, and dried for 5 minutes in a 100°F oven at ambient humidity. The wash water was maintained with 1000 ppm of test detergent throughout the evaluation.

At the end of the twenty cycles, the test glasses were rated for spots. The rating scale is 1-5 with 1

being no spots and 5 being heavily spotted. Test glasses were compared to laboratory standards and rated in a laboratory light box.

ITEM	INGREDIENT	FORMULATION NUMBER (PERCENT)			
		1	2	3	4
1	Sodium Hydroxide 50%	13.119	15.910	19.979	16.445
2	Soft Water	2.458	1.210	1.210	1.210
3	Polyacrylic Acid (50%)	3.730	3.700	3.70	3.700
4	Sodium Hydroxide Bead	32.215	30.810	30.550	32.065
5	Direct Blue 86	0.003	---	---	---
6	Sodium Tripolyphosphate	33.978	33.953	33.985	33.985
7	Coated Sodium Dichloro-isocyanurate Dihydrate	8.880	8.500	8.500	8.500
8	Mix of Linear Mono and Dialky Acid Phosphate Esters	0.267	0.592	0.561	0.561
9	EO/PO Block Terminated with PO (35% EO)	1.650	---	---	---
10	EO/PO Block Terminated with PO (39% EO)	3.700	---	---	---
11	BASF LF 221[1]	---	3.728	---	3.534
12	BASF LF 500[2]	---	1.598	1.515	---

[1] C_{13-15} Alkyl-O-$(EO)_{9-10}(BO)_{1-2}$

[2] Alcohol $(EO)_x(PO)_y$

Spot grades were as follows:

Formulation	
1	5.0
2	3.0
3	5.0
4	3.0

Results show that the BASF LF 221 is responsible for the improved spot grades vs. the detergent made with conventional block polymer surfactants.

The above specification, examples and data provide a complete description of the nature, manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

WE CLAIM:

1. A solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing capacity, which composition comprises:

(a) about 1 to 70 wt-% of a source of alkalinity;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$$RO-(EO)_x-A,$$

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50, and about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the detergent composition; wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures.

2. The composition of claim 1 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

3. The composition of claim 1 wherein the cast detergent is cast and contained within a disposable container.

4. The composition of claim 1 wherein the composition additionally comprises a source of active chlorine.

5. A solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing

capacity, which composition comprises:

(a) about 1 to 70 wt-% of a source of alkalinity;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a nonionic detergent composition selected from the group of compounds having the formulae:

$$RO-(EO)_x-A$$

and mixtures thereof, wherein R is a C_{2-24} alkyl, A is a non-aromatic capping moiety and x is 6-50; and

(d) about 5 to 45 wt-% of water of hydration,

the percentages based on the detergent composition; wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures.

6. The composition of claim 5 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

7. The composition of claim 5 wherein the cast detergent is contained within a disposable container.

8. The composition of claim 5 wherein the composition additionally comprises a source of active chlorine.

9. A solid cast warewashing detergent composition, having improved proteinaceous soil removing properties, said composition comprises:

(a) about 5 to 60 wt-% of an alkali metal hydroxide;

(b) about 5 to 50 wt-% of a condensed phosphate hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$RO-(EO)_x-A$,

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50, and about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the cast composition;

wherein the cast detergent is formed in a disposable container and is low foaming in an aqueous wash liquor at use temperatures.

10. The composition of claim 9 wherein the alkali metal hydroxide comprises sodium hydroxide.

11. The composition of claim 9 wherein the condensed phosphate hardness sequestering agent comprises sodium tripolyphosphate.

12. The composition of claim 9 which additionally comprises a source of active chlorine.

13. A solid cast warewashing detergent composition, having enhanced proteinaceous soil removing properties, which composition comprises:

(a) about 10 to 60 wt-% of sodium hydroxide;

(b) about 15 to 55 wt-% of a condensed phosphate hardness sequestering agent;

(c) about 5 to 40 wt-% of water of hydration;

(d) about 2 to 10 wt-% of an polyacrylic acid; and

(e) about 0.1 to 15 wt-% of a nonionic surfactant composition comprising:

(i) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$RO-(EO)_x-A$,

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50; and

(ii) about 0.01 to 1 parts, per each part by weight of the nonionic of (i) of a nonionic defoaming surfactant

wherein the cast detergent is formed in a disposable container and is low foaming in an aqueous wash liquor at use temperatures.

14. A method for cleaning a proteinaceous dairy soil from ware comprising a silicate glass or a ceramic cup, the method comprising:

(1) forming an alkaline cleaner comprising a major proportion of water and 0.1 to 5 wt-% of a solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing capacity, which composition comprises:

(a) about 1 to 70 wt-% of a source of alkalinity;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$RO-(EO)_x-A$,

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50, and about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the detergent composition;

wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures;

and

(2) contacting the ware having a film derived from a proteinaceous dairy soil with the alkaline cleaner at a temperature greater than 100°F in an institutional or industrial warewashing machine, resulting in clean ware.

15. The composition of claim 14 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

16. The composition of claim 14 wherein the cast detergent is cast and contained within a disposable container.

17. The composition of claim 14 wherein the composition additionally comprises a source of active chlorine.

18. A method for cleaning a proteinaceous dairy soil from ware, comprising a silicate glass or a ceramic cup, the method comprising:

(1) forming an alkaline cleaner comprising a major proportion of water and 0.1 to 5 wt-% of a solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing capacity, which composition comprises:

(a) about 1 to 70 wt-% of a source of alkalinity;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$$RO-(EO)_x-A,$$

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50, and about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the detergent composition;

wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures; and

(2) contacting the ware having a film derived from a proteinaceous diary soil with the alkaline cleaner at a temperature of 100°F in an institutional or industrial warewashing machine and produce clean ware.

19. The composition of claim 18 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

20. The composition of claim 18 wherein the cast detergent is contained within a disposable container.

21. The composition of claim 18 wherein the composition additionally comprises a source of active chlorine.

AMENDED CLAIMS

[received by the International Bureau on 24 July 1995 (24.07.95); original claims 1,5 and 9 amended; new claims 22-25 added; remaining claims unchanged (7 pages)]

1. A solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing capacity, which composition comprises:

(a) about 1 to 70 wt-% of an alkali-metal hydroxide ;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of (i) a nonionic detergent composition, having the formula:

$$RO-(EO)_x-A,$$

wherein R is a C_{2-24} alkyl, A is a capping moiety comprising an alkyl group, a halogen group, a group derived from a C_4 or higher alkylene oxide, or mixtures thereof and x is 6-50; and (ii) about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the detergent composition;

wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures.

2. The composition of claim 1 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

3. The composition of claim 1 wherein the cast detergent is cast and contained within a disposable container.

4. The composition of claim 1 wherein the composition additionally comprises a source of active chlorine.

5. A solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing capacity, which composition comprises:

(a) about 1 to 70 wt-% of an alkali-metal hydroxide;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a nonionic detergent composition selected from the group of compounds having the formulae:

$$RO-(EO)_x-A$$

and mixtures thereof, wherein R is a C_{2-24} alkyl, A is a non-aromatic capping moiety comprising an alkyl group, a halogen, a group derived from a C_4 or higher alkylene oxide, or mixtures thereof and x is 6-50; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the detergent composition;

wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures.

6. The composition of claim 5 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

7. The composition of claim 5 wherein the cast detergent is contained within a disposable container.

8. The composition of claim 5 wherein the composition additionally comprises a source of active chlorine.

9. A solid cast warewashing detergent composition, having improved proteinaceous soil removing properties, said composition comprises:

(a) about 5 to 60 wt-% of an alkali metal hydroxide;

(b) about 5 to 50 wt-% of a condensed phosphate hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of (i) a nonionic detergent composition, having the formula:

$$RO-(EO)_x-(\text{alkylene oxide})_y$$

wherein R is a C_{2-24} alkyl, alkylene oxide is a C_4 or higher alkylene oxide, x is 6-50, and y is 1-5; and (ii) about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration,

the percentages based on the cast composition; wherein the cast detergent is formed in a disposable container and is low foaming in an aqueous wash liquor at use temperatures.

10. The composition of claim 9 wherein the alkali metal hydroxide comprises sodium hydroxide.

11. The composition of claim 9 wherein the condensed phosphate hardness sequestering agent comprises sodium tripolyphosphate.

12. The composition of claim 9 which additionally comprises a source of active chlorine.

13. A solid cast warewashing detergent composition, having enhanced proteinaceous soil removing properties, which composition comprises:

(a) about 10 to 60 wt-% of sodium hydroxide;

(b) about 15 to 55 wt-% of a condensed phosphate hardness sequestering agent;

(c) about 5 to 40 wt-% of water of hydration;

(d) about 2 to 10 wt-% of an polyacrylic acid; and

(e) about 0.1 to 15 wt-% of a nonionic

surfactant composition comprising:

(i) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$$RO-(EO)_x-A,$$

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50; and

(ii) about 0.01 to 1 parts, per each part by weight of the nonionic of (i) of a nonionic defoaming surfactant

wherein the cast detergent is formed in a disposable container and is low foaming in an aqueous wash liquor at use temperatures.

14. A method for cleaning a proteinaceous dairy soil from ware comprising a silicate glass or a ceramic cup, the method comprising:

(1) forming an alkaline cleaner comprising a major proportion of water and 0.1 to 5 wt-% of a solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing capacity, which composition comprises:

(a) about 1 to 70 wt-% of a source of alkalinity;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$$RO-(EO)_x-A,$$

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50, and about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the detergent composition;

wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures; and

(2) contacting the ware having a film derived from a proteinaceous dairy soil with the alkaline cleaner at a temperature greater than 100°F in an institutional or industrial warewashing machine, resulting in clean ware.

15. The composition of claim 14 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

16. The composition of claim 14 wherein the cast detergent is cast and contained within a disposable container.

17. The composition of claim 14 wherein the composition additionally comprises a source of active chlorine.

18. A method for cleaning a proteinaceous dairy soil from ware, comprising a silicate glass or a ceramic cup, the method comprising:

(1) forming an alkaline cleaner comprising a major proportion of water and 0.1 to 5 wt-% of a solid cast alkaline warewashing detergent composition, having improved proteinaceous soil removing capacity, which composition comprises:

(a) about 1 to 70 wt-% of a source of alkalinity;

(b) an effective water treating amount of a hardness sequestering agent;

(c) about 0.1 to 15 wt-% of a blend of a nonionic detergent composition having the formula:

$$RO-(EO)_x-A,$$

wherein R is a C_{2-24} alkyl, A is a capping moiety and x is 6-50, and about 0.01 to 1 parts by weight of a nonionic defoamer per each part of the nonionic detergent; and

(d) about 5 to 45 wt-% of water of hydration, the percentages based on the detergent composition;

wherein the detergent composition is used in an aqueous wash liquor and is low foaming at operating temperatures; and

(2) contacting the ware having a film derived from a proteinaceous diary soil with the alkaline cleaner at a temperature of 100°F in an institutional or industrial warewashing machine and produce clean ware.

19. The composition of claim 18 wherein the hardness sequestering agent comprises an inorganic hardness sequestering agent.

20. The composition of claim 18 wherein the cast detergent is contained within a disposable container.

21. The composition of claim 18 wherein the composition additionally comprises a source of active chlorine.

22. The composition of claim 1 wherein the nonionic detergent composition has the formula $RO-(EO)_x-(\text{alkylene oxide})_y$ wherein alkylene oxide is a C_4 or higher alkylene oxide and y is 1-5.

23. The composition of claim 5 wherein the nonionic detergent composition has the formula $RO-(EO)_x-(\text{alkylene oxide})_y$ wherein alkylene oxide is a C_4 or higher alkylene oxide and y is 1-5.

24. The composition of claim 1 wherein the nonionic detergent composition has the formula $RO-(EO)_x-(BO)_y$ wherein BO is a moiety derived from a butylene oxide and y is 1-5.

25. The composition of claim 5 wherein in the nonionic detergent composition having the formula $RO-(EO)_x-(BO)_y$ wherein BO is a moiety derived from a butylene oxide and y is 1-5.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 95/02283

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C11D 17/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C11D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO, A1, 9012081 (ECOLAB INC.), 18 October 1990 (18.10.90), page 6, line 22 - page 7, lines 1-2; page 7, line 35 - page 8, lines 1-3; claims 1-3, 12-21,24	1-21
X	WO, A2, 8911753 (ECOLAB INCORPORATED), 30 November 1989 (30.11.89), page 8, line 3 - line 23, claims 1,6	1-21
A	EP, A1, 0034275 (BASF AKTIENGESELLSCHAFT), 26 August 1981 (26.08.81), page 2, line 30 - line 33; page 3, line 5 - line 12, claim	1-21

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 1995	21. 06. 95
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Authorized officer DAGMAR JÄRVMAN

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 95/02283

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR, A1, 2247532 (OLIN CORPORATION), 9 May 1975 (09.05.75)	1-21
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E	WO, A1, 9506713 (FLEISHER, HOWARD), 9 March 1995 (09.03.95)	1-21
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INTERNATIONAL SEARCH REPORT

Information on patent family members

03/05/95

International application No.
PCT/US 95/02283

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		EP-A,B- 0465461	15/01/92
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